

Further Clarification of “New Einstein Gravitation”

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Received February 10, 2007; Published online April 11, 2007

I wish to explain further here the ideas of Cartan and my paper “New Einstein Gravitation”.⁽¹⁾ It is not a question of constructing a different theory, but another interpretation, taking into account the fault hinted at by Einstein that the flow of time is an illusion and therefore that particles follow their trajectories according only to their proper times. When Cartan gives in the tangent space at each point a frame adapted to the group considered, he does not specify the system of coordinates, and still less a frame naturally defined by the coordinates; there are therefore no *vierbeins*, the objects with two indices. The tangent space is in fact a notion intrinsic to the manifold. The form ω puts into correspondence to a vector f a number or an element of an algebra. The exterior product is defined in general as

$$\omega_1 \wedge \omega_2(f_1, f_2) = \omega_1(f_1)\omega_2(f_2) - \omega_1(f_2)\omega_2(f_1)$$

Therefore one permutes the vectors and not the values taken by the forms. For the particles following trajectories which are timelike, one can make the assumption with Einstein that these are geodesics and so one does not have the interpretation of spacelike curves in R^4 . One requires a connection, but why to choose that of Lévi-Civita? On the other hand, Einstein is mistaken; the particles remain confined in an R^3 contained in R^4 , but then which one? The answer is simple. It is the one which has been taken at the beginning to construct the R^4 , and therefore in a change of the Galilean frame the R^3 is the same and it is the R^4 that changes. One must therefore define a connection for this R^3 which is now non-Euclidean (this is

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the inspired idea of Einstein). This is why I have chosen the connection for which $\omega_{ij} = \omega_{ji} = 0$ for such R^3 , which then necessarily has torsion (see my paper Ref. 1). It is not correct to deduce that an object which moves freely does not turn, but there is not in addition a rotation due to the Lévi-Civita connection, a very little term (see the reference to Garidi in my paper Ref. 1). The predictions remain almost the same, and the theory is preserved.

REFERENCE

1. C. Piron, *Found. Phys.* **35**, 1643 (2005).